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Physica B 289–290 (2000) 291–294

PHYSICA B

www.elsevier.com/locate/physb

Antiferromagnetism in water doped $YBa_2Cu_3O_{6+x}$ for $x \sim 0.5$

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Abstract

We report zero-field (ZF) μSR on a series of antiferromagnetic (AFM) samples of $YBa_2Cu_3O_{6.4}$ reacted with water. We find several oscillating signals whose amplitudes vary with water content and temperature, and for high water contents, a non-oscillating component. The Néel transition is 395(5) K, characteristic of the undoped CuO_2 bilayer. Initial comparison with ZFμSR and ZFNMR measurements in related AFMs ($PrBa_2Cu_3O_7$ and H doped $YBa_2Cu_3O_7$) suggests a similar muon site *and* an AF structure which is similar, but distinct from $YBa_2Cu_3O_6$.

Keywords: Cuprate antiferromagnetism; $YBCO_6$; $PrBCO_x$

Reaction of water with the well-known cuprate superconductor $YBCO_{6+x}$ for $x < 1$ leads to intercalation of H_2O or related species into the partially occupied chain layer yielding an insulating antiferromagnet [1,2]. The structure of the product of this reaction is an analogue of the 1248 superconductor with Cu vacancies in the (double) chain layer [3]. When the reactant is well-ordered ortho-II $YBCO_{6.5}$ (see Ref. [4] for recent refined structural studies), the resulting AFM has a very well-defined Cu ZFNMR spectrum which differs significantly from pure $YBCO_6$ (the AFI phase with an ordered moment of $\sim 0.6\mu_B$ on the plane copper (Cu(2) [5]). Detailed studies of this compound are desirable because they amount to characterization a potentially common impurity phase,[1] and more significantly, a difference in AF structure which is suggested by the ZFNMR could be used to better determine the parameters governing the AF ordered phase and, as a corrollary, the remnant antiferromagnetism which is important in determining the properties of the metallic state (including T_c [6]).

In order to understand the origin of the differences observed in ZFNMR [1,2] between this AFM and $YBCO_6$, we performed μSR studies on

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[1] The reaction takes place (albeit slowly) at room temperature with ambient water vapour, even in conventional dessicators or for epoxy packed samples.

0921-4526/00/$ - see front matter
PII: S0921-4526(00)00395-1